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ABSTRACT

This paper describes the basic knowledge necessary to promote the students' ability to analyze, design, and construct information systems. The curricula and the practical teaching material are proposed with which students can experience information system development by applying the basic knowledge of lectures. The subjects of the basic knowledge are programming, software design, information system development, database, and network. Retail management is taken up as one of the practical teaching materials for students to learn the relationship between basic subjects; students study the requirements of a wholesale shop and design a new system. Until now, students have stayed within the fragmentary knowledge of lectures. Yet, with this teaching material, they can acquire practical ability doing concrete analysis, design, and construction. (Author/MES)

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Information System Design of Undergraduate Education: Combining Lectures with Practice

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Abstract: *This paper describes the basic knowledge necessary to promote the ability that students can analysis, design, and construct information systems. The curricula and the practical teaching material are proposed, with which students can experience information system development by applying the basic knowledge of lectures. The subjects of the basic knowledge are programming, software design, information system development, database, and network. "Retail management" is taken up one of the practical teaching material for students to learn the relationship between basic subjects. Up to now students have stayed in the fragmentary knowledge of lectures. Yet, with this teaching material, they can acquire practicing ability doing voluntarily concrete analysis, design, and construction in practice.*

Introduction

The use of the computer is ubiquitous in today's business communities, and is becoming so in education. However, concerning the information system design, there are few practice teaching materials which organically tie to the lecture in order to teach the latest content. Engineering skills demanded today require the ability to synthesize basic subjects into design and to be able to analyze design solution to points, ultimately leading to a high quality product which can compete economically in the marketplace. The development of this type of knowledge in our students requires us to provide them with more hands-on experiential learning.

The basic subjects of lectures are programming, software design, information system development, database, and network. Figure 1 illustrates a location of subjects by information system design. The center of the Figure 1 is a nucleus of information system design. This part corresponds to a nucleus of a computer and its nearest seeds. The technological innovation of these seeds is aggressive. On the other hand, the outside represents human society and the basis of needs for the computer. The change in needs of human society is slower than the technological innovation of seeds. The center of Figure 1 contains seeds. The display of Figure 1 becomes near needs while facing from this center towards the outside.

On the other hand, this practice teaching material starts from the information system development methodology by which the information system is defined based on users' needs and restrictions. This assists us in making programming through the software design and the database design. If the concept of object-oriented methodology (Booch, 1994) is applied, it is thought that the abstracted lecture is a class, and the practice corresponds to an object in the world of the information and computer science education.

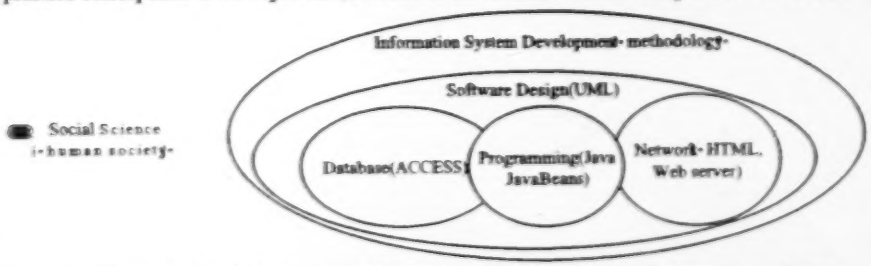

Figure 1: A relation between the basic subjects about information system design

Basic subjects

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1)Programming; We choose JAVA in our practice classes. There are three reasons for this: JAVA is congenial with the Web browser of the Internet; JAVA is compatible as an object-oriented language; and teaching the concept of structuralization and abstraction is easy.

2)Network; HTML and Web-server are taken up in the practice. The server is constructed to acquire the basis of a decentralized system which improves the performance, and the network is studied by expanding the function and operating systems.

3)Database; The relational database is widely used today. ACCESS database is congenial with WindowsNT, and for this reason, we use it (Fujio, 1996).

4)Software design; It is necessary for students to use the methodology properly according to an object area, and to know various methodologies well (Saeki, 1998). It is preferable to exercise various methodologies in practice. However, if we condense it to one methodology, recent object-oriented analysis and design is the best approach. In the case of this situation, we model an object area by using the UML (Quantrani, 1998), which is the latest unified modeling language. By using the UML, students design a use case, an object diagram, a sequence diagram, and a status diagram of the object area.

5)Information system development; We use the methodology in practice but we do not use tools. Students should interview users, operators, and managers in the object area based on methodology and examine the present situation. They research the problems, and draw an ideal system image that can solve these problems. They should also settle on the system image which can be developed actually in outline books considering: policies; social and technical constrained conditions; and the cost performance. Students should experience this process as practice and teachers should evaluate the achievement.

Practice teaching material

Retail management is taken up as a practice teaching material. Students take new requirements to the current system of a wholesale shop, and design a new system. First of all, students start with a grasp of the current business of the wholesale shop (IPA, Asupa Co., 1993), which is the object system, and they investigate it to understand the flow of information, money, and commodities between sections.

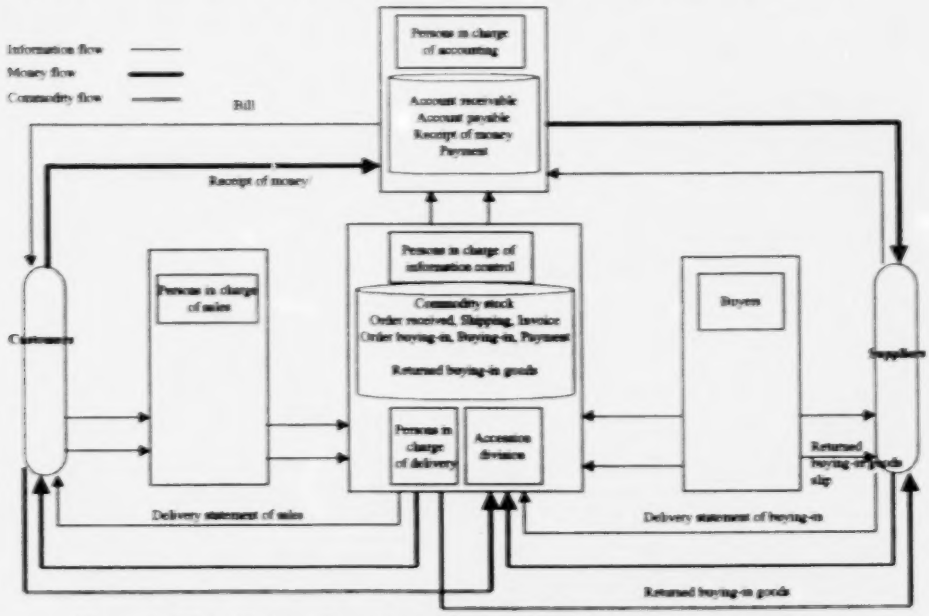

Figure 2: Flow of information and organization of the wholesale shop; new system

Students make a plan for the wholesale shop to develop the new system that includes the following

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requirements for the current system:

1) The wholesale shop connects the commodity headquarters, the offices, and the warehouses with the network, and makes paper transactions electronic. The commodity headquarters consists of buyers, persons in charge of accounting and commodity control. The office means persons in charge of sales. The warehouse consists of persons who handle accepting and delivering the commodity.
2) To give the system generality and to build it cheaply, they construct the information system by using client-server systems and Intranet.
3) They make the system which corresponds easily to its evolution, expansion, and maintenance using object-oriented methodology.
4) A database system is used to accumulate a large amount of data and to process it. Figure 2 shows the new system that realizes the achievement of the plan

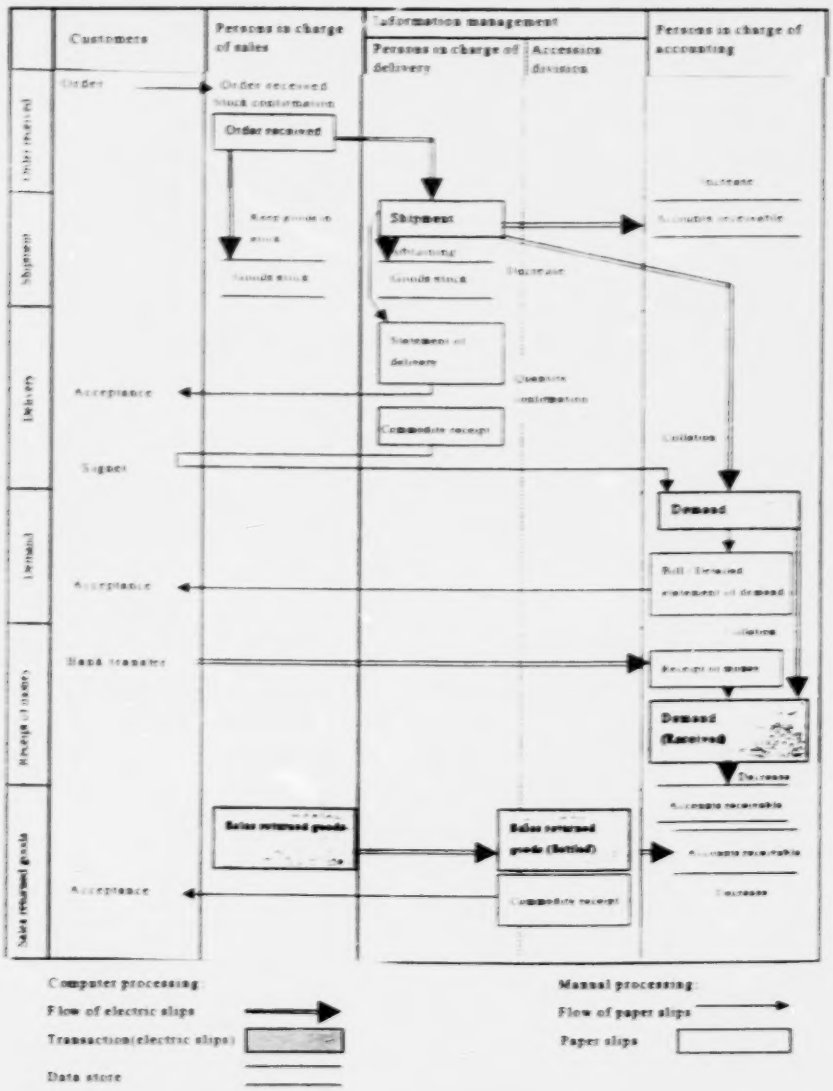

Figure 3: Flow of information and slips concerning sales business

After the business reformation, Figure 3 shows the flow of information, slips, money, and goods

between the sections: persons in charge of sales; information control; accounting; and buyers. Thereafter, the design is advanced according to the procedure of the sales business in Figure 3. The architecture of this system is composed of three elements, which are human interfaces (screen), databases, and business processes (business procedure). At the stage of the framework design, it is decided how to characterize and design the outline of three elements. They must consider overall network, computer and OS, programming language and components, and databases, what is more, a trend of the industry and the business. They bring the whole system together while making these three elements detailed.

Human interface

The slips are human interfaces in the current system. The input and output items needed in the new system are added, and the I/O screen which is the new human interface, is designed. Figure 4 is the example of the order received processing screen.

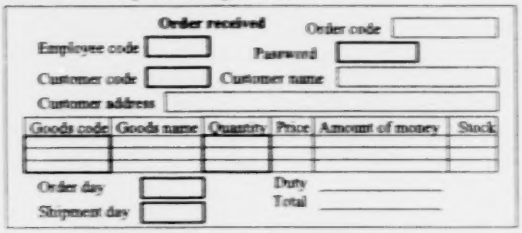

Figure 4: Screen of order received

Database

First of all, all necessary data is dug up based on this screen in the new system. Next, in order to remove a repetition of data, they normalize the data and make the table, that is to say, design the database. .

Business process

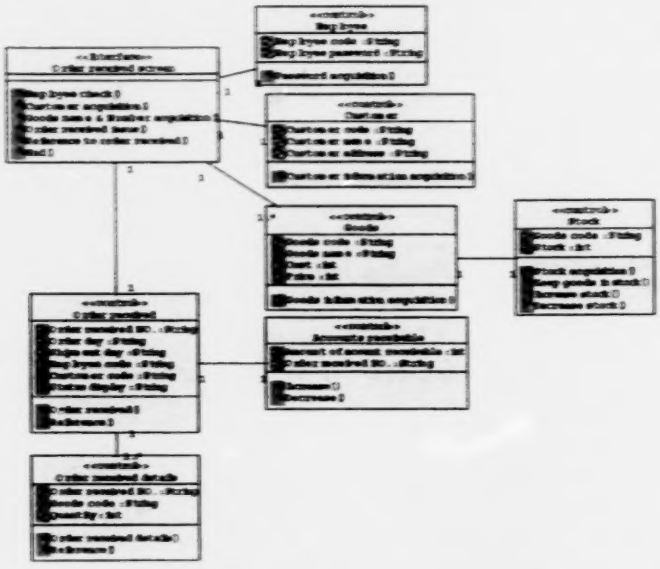

Figure 5: Class diagram of sales business

Using the UML description (Eriksson, Penker, 1998), the class diagram (Figure 5) which concerns

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the sales business is made by extracting CLASS/OBJECT. The order received processing procedure between the screen and the database is shown in the sequence diagram based on this class diagram. In addition, the status diagram, which expresses status transition of the order received slip, is made. Its order received slips (electric slips) are the main information in the sales processing. They are the ones taking the place of the paper slips, which are transmitted between the sections in the current system.

Program design using components

The system configuration is a client/server. Applet made by JAVA and database is arranged in the server's machine. After this Applet was called from the server to the client by World Wide Web, the commodity code and the quantity of goods are inputted into the screen of the Applet, that is to say, the retrieval and the update of the commodity data are directed. Because this Applet is connected through pure Java driver (Imprise 1998) with the database on the server, the commodity data on the database is retrieved according to the retrieval instruction of persons in charge of sales, as it turned out, the commodity data is displayed in the Applet on the client's machine. Moreover, the contents of the database on the server can be updated in the instruction of the update. JavaBeans; components made by JAVA, are used to design. It seems reasonable to use JavaBeans to design the screen and database so that making and maintaining the software becomes simple compared to programming with JAVA. Figure 6 constitutes one example of the programming code added to JavaBeans for the customer information retrieval.

```
void customerField_keyPressed(KeyEvent e) {
    //[enter] When the key is pressed
    if (e.getKeyCode() = = KeyEvent.VK_ENTER){
      try {
          parameterRow2.setString("CUSTOMER",customerField.getText());
      //The customer code is set in the parameter
          queryDataSet2.refresh();  //The record of customer code is retrieved
          String x = queryDataSet2.getString(0);//Retrieved customer code
          String y = customerField.getText();//Customer code inputted to screen
          if (x.equals(y)){
                    customerNameField.setText(queryDataSet2.getString(1));
              // The customer name is displayed
                    addressField.setText(queryDataSet2.getString(2));
              // The customer address is displayed
          }
          else
                    statusBar1.setText("The customer code is wrong");
      }
      catch (Exception ex){
          ex.printStackTrace(); }
   }
}
```

Figure 6: Retrieval of customer information based on customer code

Conclusion

Students plan the new system, after they understand the whole elements (seeds) which compose information systems, an industry trend, and new requirements (needs) of business. At the stage where the object system is analyzed, the requirements are analyzed and defined using the similar diagram (Figure 3) to a business flow. This diagram is more specialized for business than use-case used (Schneider, Winters 1998) by the object-oriented analysis-design. As for systems annalists skilled in the business, in order to analyze and design a novel system in a short term based on their general situation judgments, they often use

the diagram specialized on the business. As for the design of the screen, the database, and the business process in the framework of a new system, it is necessary to decide the priority, that is, which should be designed emphatically at the object system. This method is a realistic technique with which top down and bottom up are combined. The entire systems are integrated while designing each outline, and are broken down.

HTML used in the screen design, ACCESS used by database, and JavaBeans and JAVA used by business process design are an individual design element group, students must study those subjects through lectures previous to this practice. As a result, they will understand relations between the subjects through this practice. The programming, which uses JAVA, is indispensable for understanding the concept of object-oriented methodology. However, the use of common components (JavaBeans) composed of JAVA is effective to develop actual information systems if object systems are complex. Therefore, students should be skilled in usage of common components. After designing rough specifications of the screen and database, they design components, and mount components being combined, and what is more, program undefined parts of details using JAVA.

Considering students for departments of social science, this teaching material steps into the area which affects the society. Moreover, because it is possible to design from the user requirement definition to the programming consistently, students will be able to understand each position of basic subjects from experience. A basic technology of Internet and the latest object-oriented analysis-design can be experienced at the same time. In conclusion, I should note that the knowledge obtained by the lecture could be improved even to practical ability through the substantial practice.

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